Idaho Numeric Nutrient Target Development

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Current Nutrient Standard

- ***06. Excess Nutrients.*** *Surface waters of the state shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses.*

Numeric Criteria Background

- National Push for Numeric Nutrient Criteria on a National level
  - Including Idaho
- Ecoregional Criteria
  - Xeric West
  - Western Forested Mountains
  - Did not account for variability in nutrient concentrations
    - Idaho is large State
- Idaho has considered numeric criteria before…
  - 1999
  - Early 2000's
  - 2003 - 2007 – no significant correlation (periphyton: nutrients)
  - Currently in partnership with Tetra Tech

The role of numeric nutrient criteria in Idaho

- Retain Narrative criteria
  - Couple with numeric
    - Serve as trigger values
      - Follow monitoring and investigation
- Future Steps
  - Verify results of the current project
    - Statewide
    - Increase sample size of reference sites

Project Data

- Dataset
  - 2004 + 2013 field seasons
  - >200 sites
  - Reference and stressed
    - GIS
- Dataset includes:
  - Diatoms, periphyton assemblages, algal biomass, chlorophyll *a*, TN, TP, TKN, N+N, ammonia, phosphate, pH, DO
  - Algal and habitat qualitative ratings (2013)

Reference Site Selection

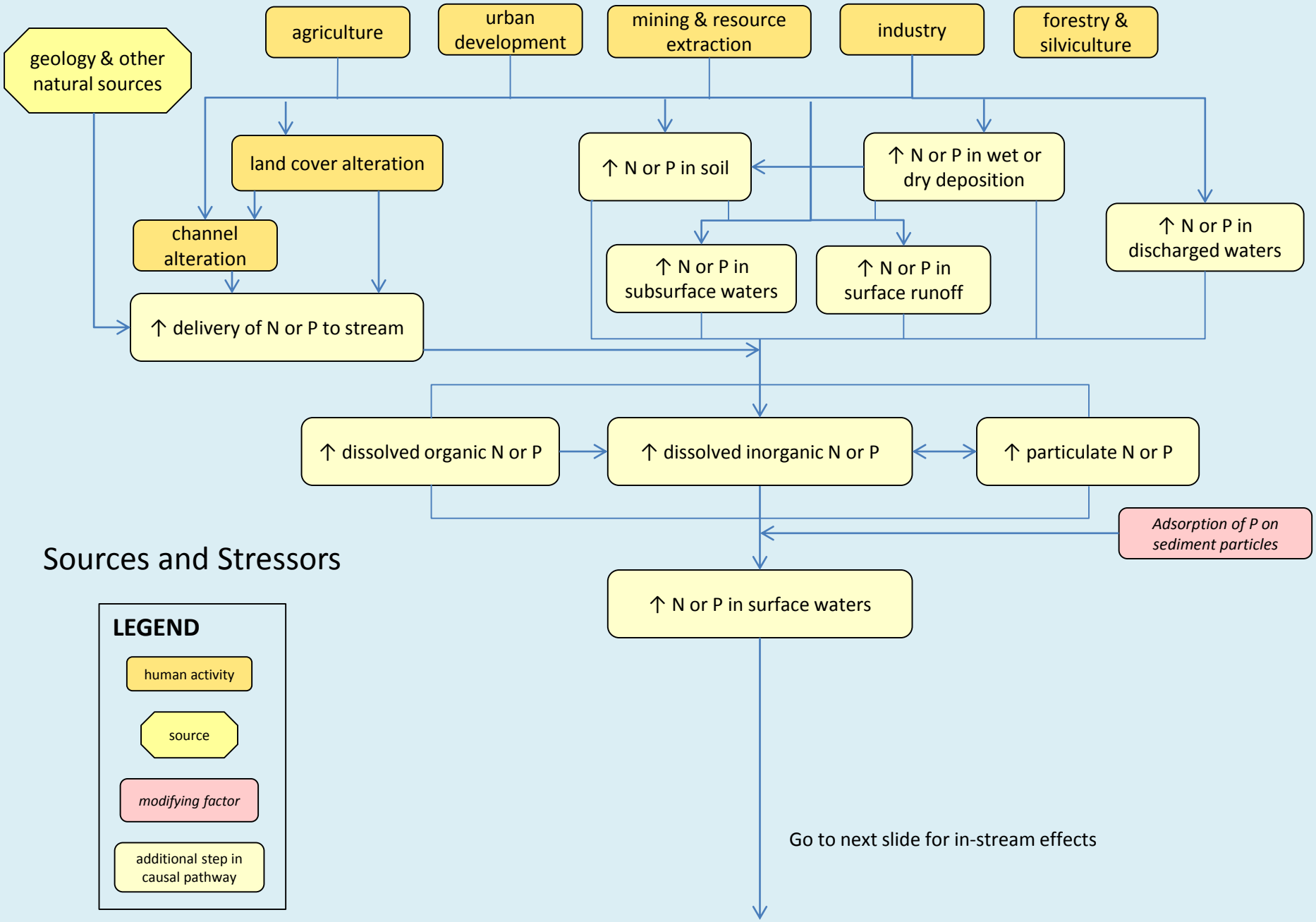
- Site selection accounts for natural variability in nutrient concentrations
- Reference sites defined using measures of human activity in watershed
  - pop, % natural land use, disturbance, roads, diversions, NPDES, dams, grazing, riparian pressure
- Evenly distributed across Idaho

Project Questions

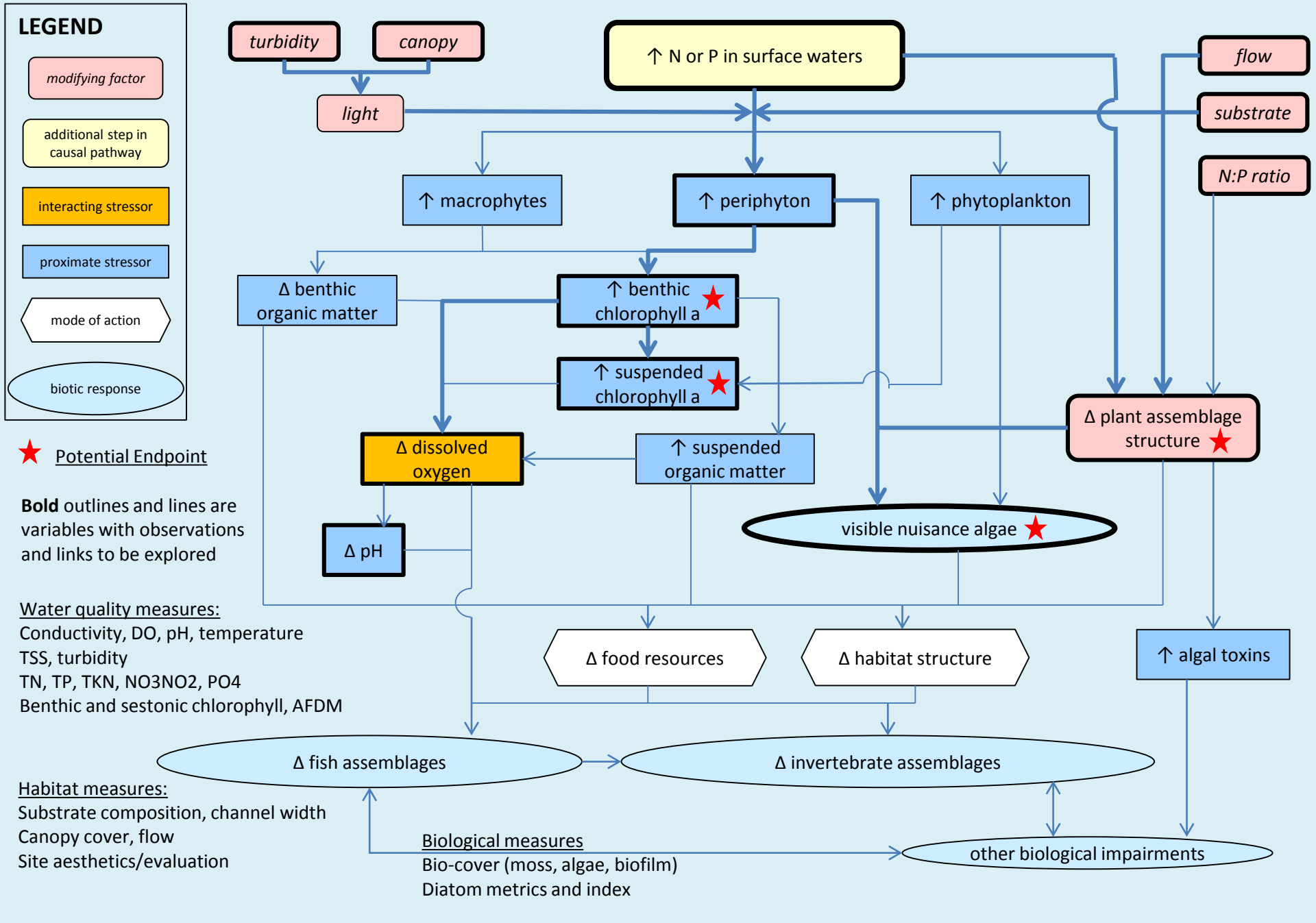
1) *Can visible slime growths or nuisance aquatic growths be defined quantitatively?*
2) *Are nutrients associated with these growths in a stressor-response context?*
3) *Can nutrient benchmarks be established to protect against unwanted visible slime growths or nuisance aquatic growths?*

Project Goals

- *Nutrient endpoints determined from frequency distribution analysis*
- *Nutrient endpoints determined from modeled reference expectation*
- *Nutrient endpoints from stressor response analysis*



Sources and Stressors

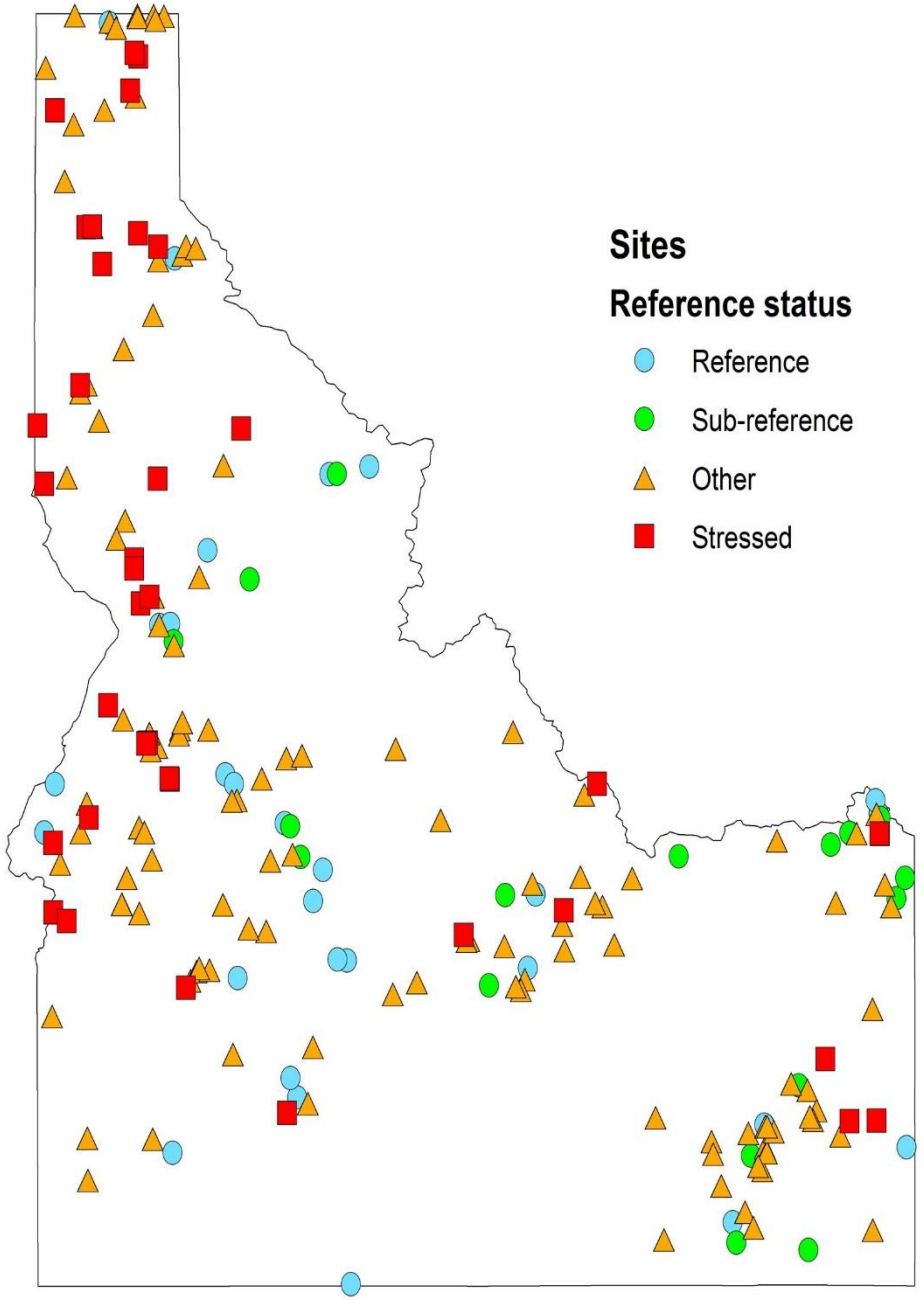

LEGEND
modifying factor
additional step in causal pathway
interacting stressor
proximate stressor
mode of action
biotic response
Potential Endpoint
Bold outlines and lines are variables with observations and links to be explored
Water quality measures:
Conductivity, DO, pH, temperature
TSS, turbidity
TN, TP, TKN, NO3NO2, PO4
Benthic and sestonic chlorophyll, AFDM
Habitat measures:
Substrate composition, channel width
Canopy cover, flow
Site aesthetics/evaluation
Biological measures
Bio-cover (moss, algae, biofilm)
Diatom metrics and index
turbidity
canopy
light
↑ N or P in surface waters
flow
substrate
N:P ratio
↑ macrophytes
↑ periphyton
↑ phytoplankton
Δ benthic organic matter
↑ benthic chlorophyll a
↑ suspended chlorophyll a
Δ dissolved oxygen
↑ suspended organic matter
Δ plant assemblage structure
Δ pH
visible nuisance algae
Δ food resources
Δ habitat structure
↑ algal toxins
Δ fish assemblages
Δ invertebrate assemblages
other biological impairments

Analytical Goals

- Use the quantitative data from 2004 and 2013 to support some of the linkages in the conceptual model
- Emphasis was on nutrients (TN and TP)
- Diatoms were the primary response
- Establish expectations for nutrient conditions
  - Found in least disturbed sites
  - Aligned with better diatom metric values

Analytical Steps

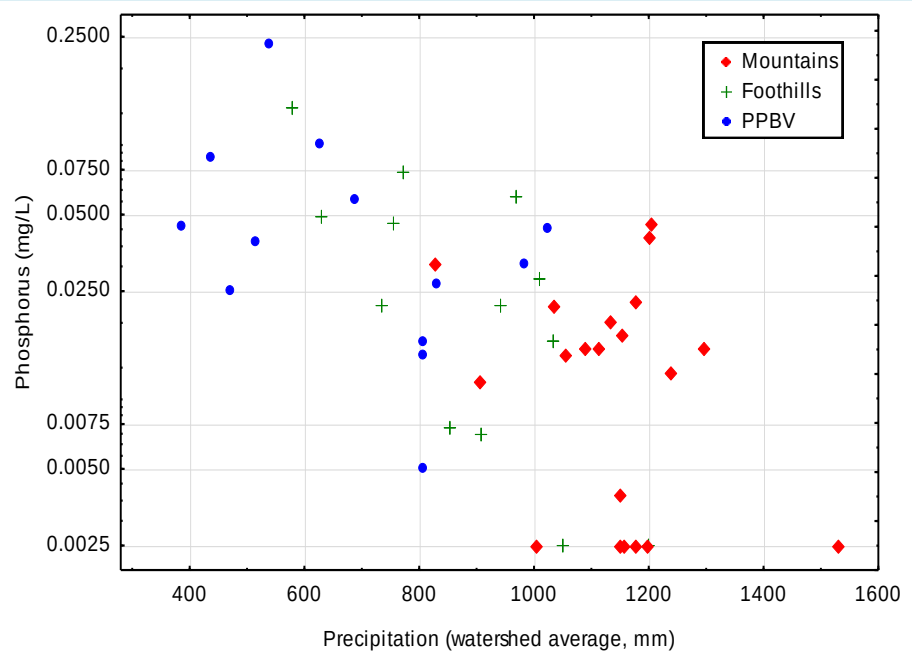
- Define the disturbance gradient
- Distinguish nutrient site classes
- Characterize nutrient distributions
- Model reference conditions
- Stressor-response analysis
  - Change-points
  - Regression interpolation



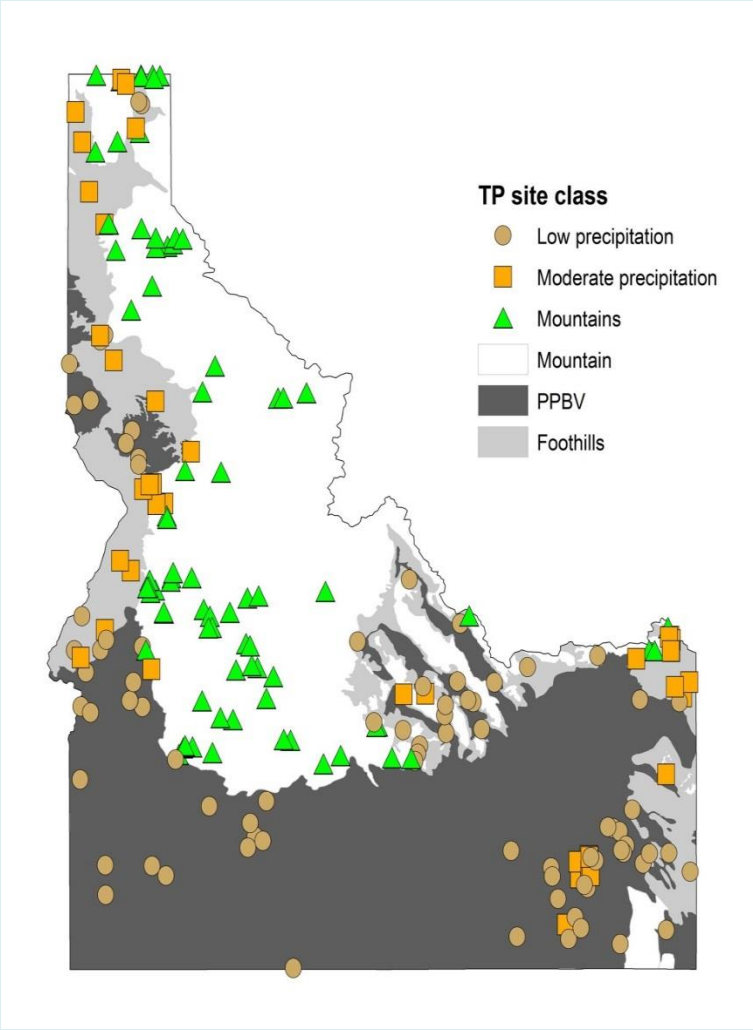
Disturbance Gradient

- 29 of 208 sites were reference
- Mountain sites were more likely to be reference
- Also found stressed sites

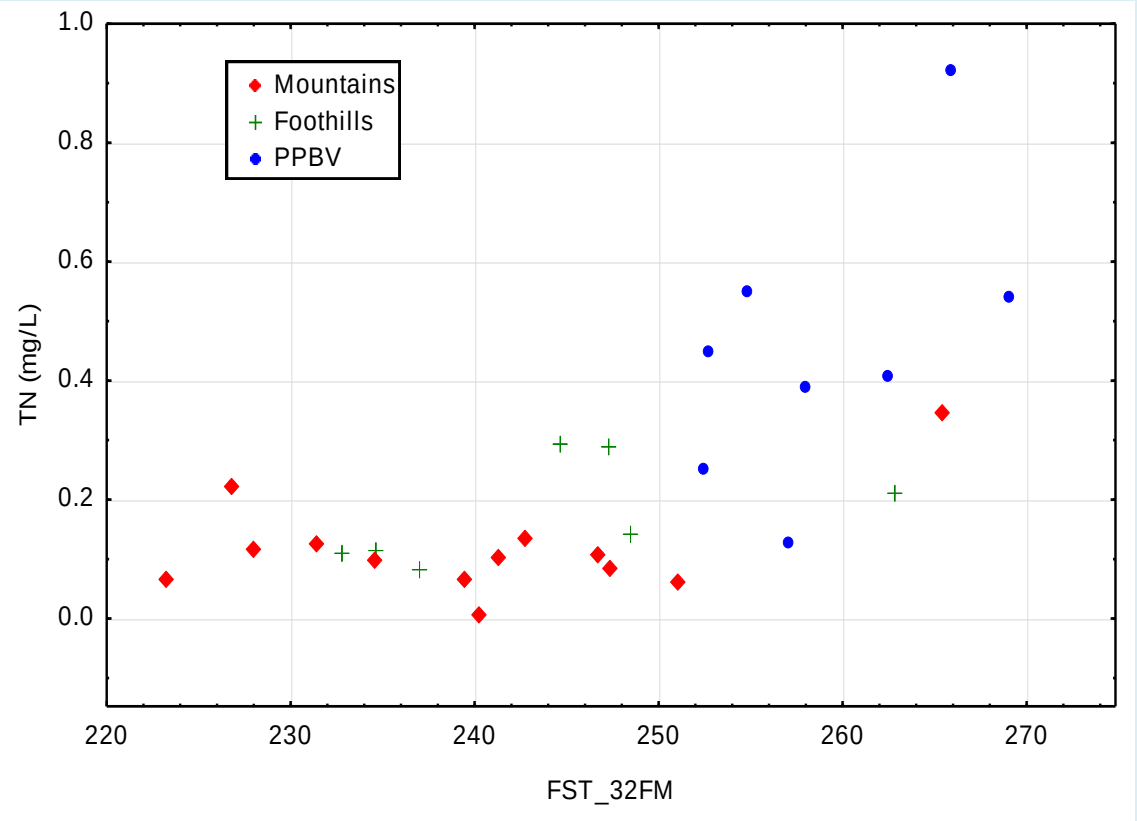
TP Site Classes

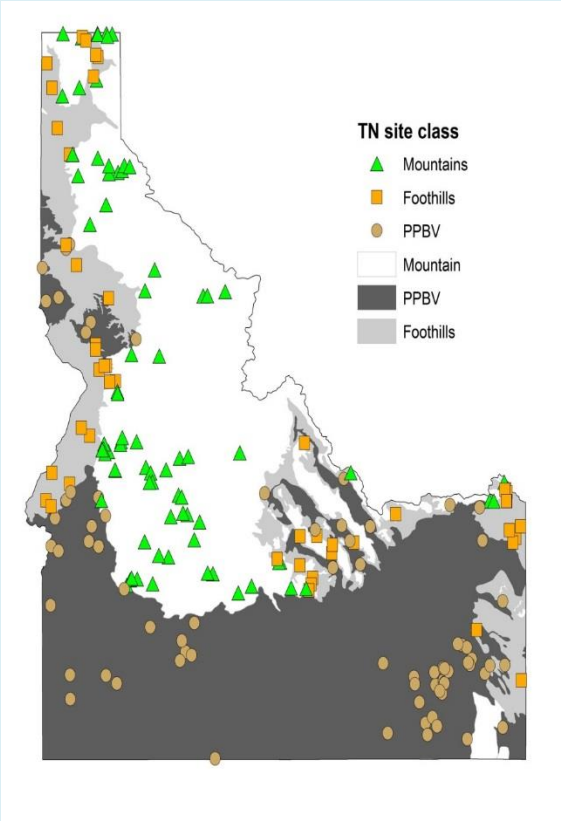


- Low, Moderate, and High Precipitation (High precip in mtns)



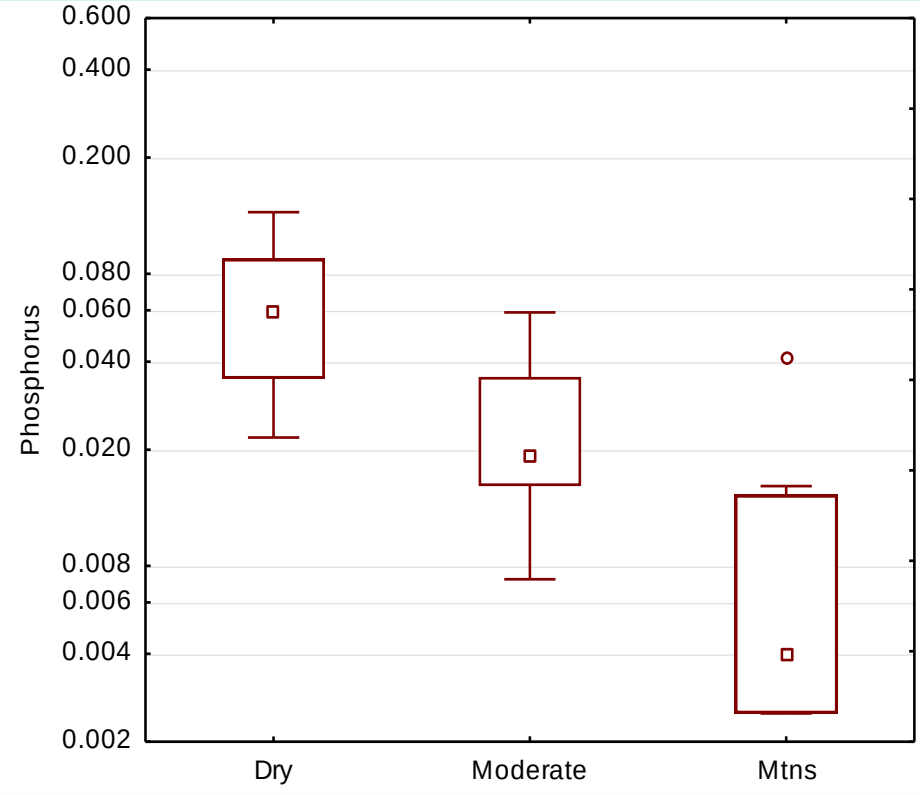
TN Site Classes



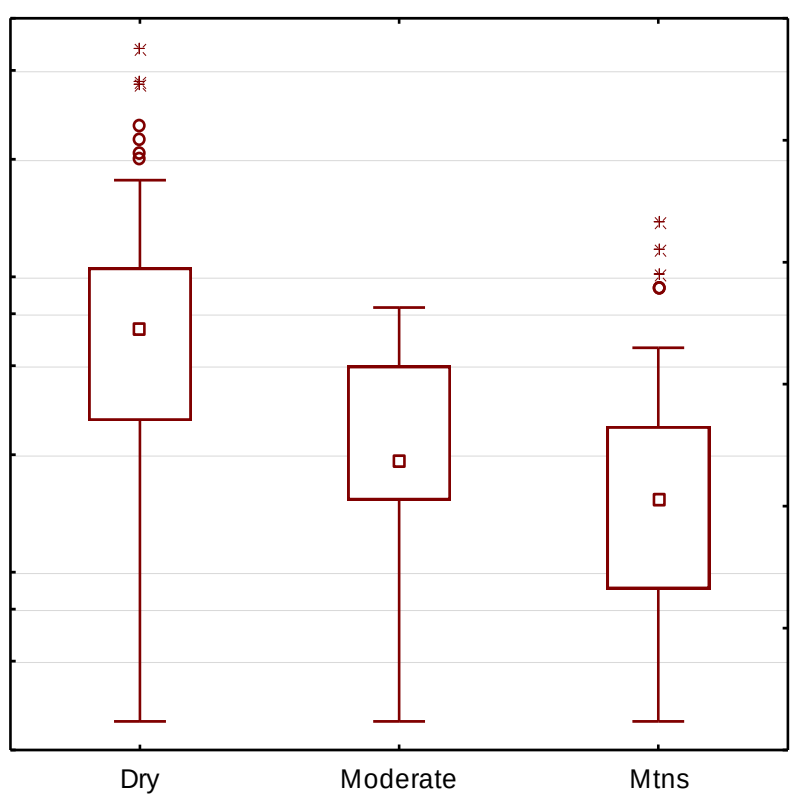


Mountains, Foothills, & PPBV (like biological indicators)

Distribution Statistics



Reference only

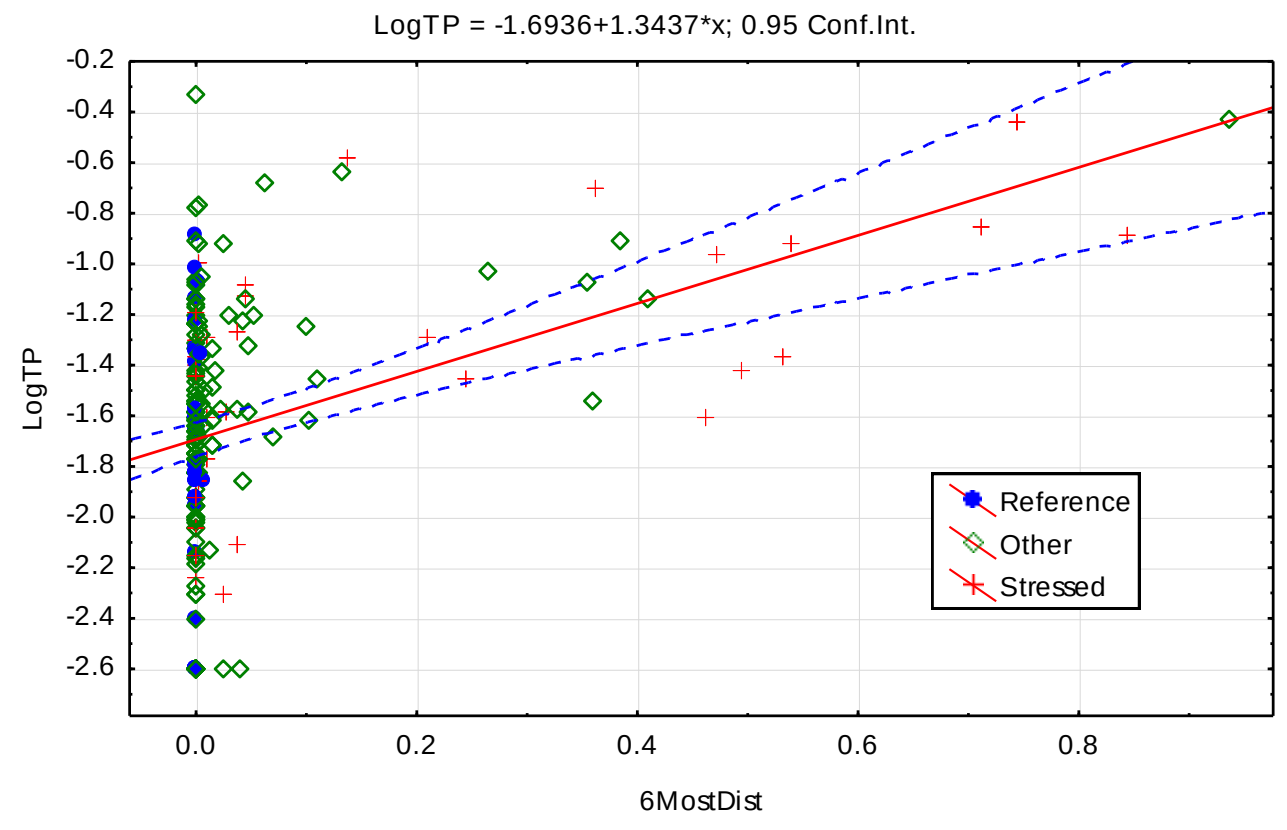


All sites

Modeled Reference Conditions

TP: Linear regression with land use

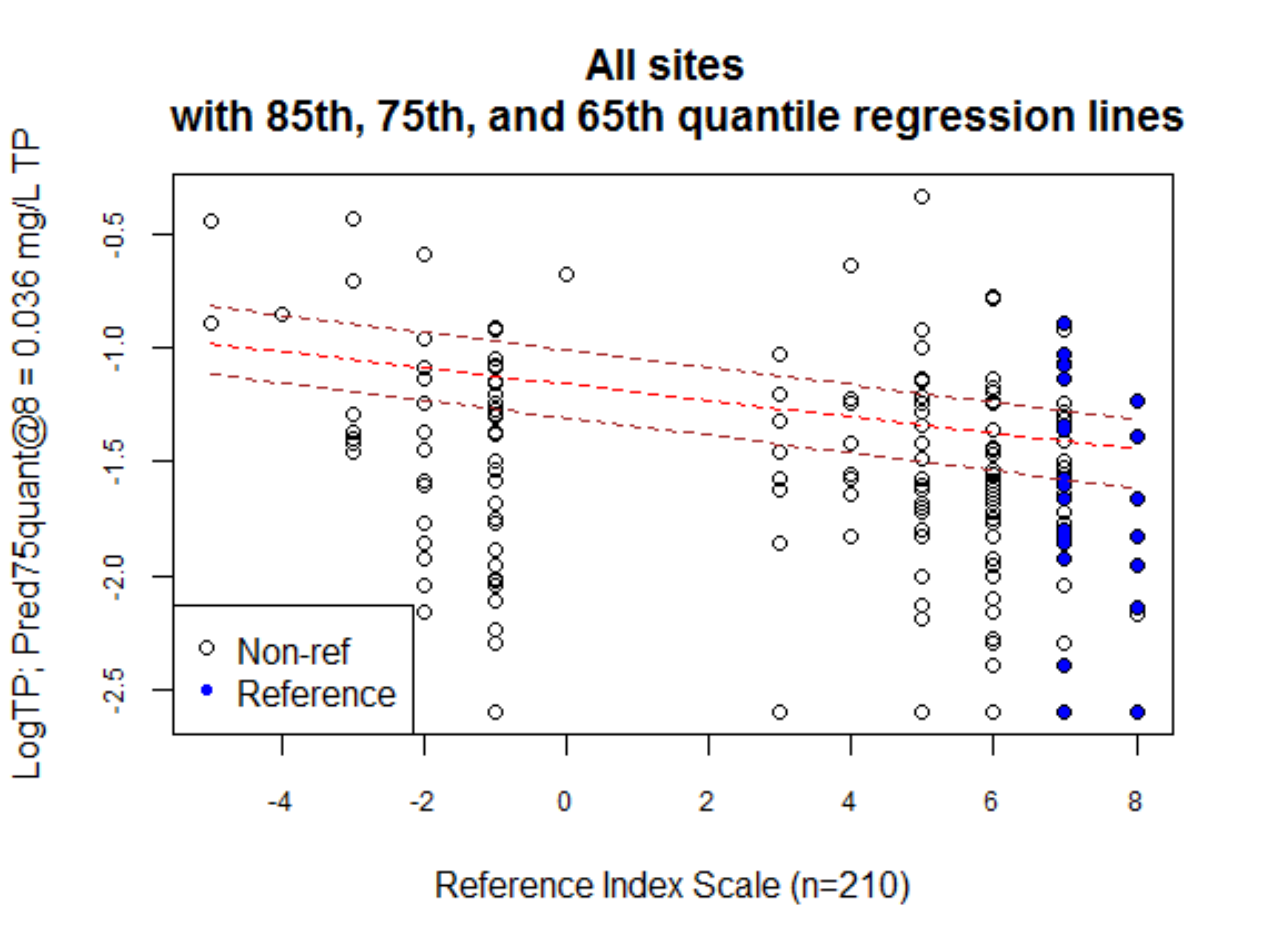
Intersection with zero disturbed land = 0.02 mg/L



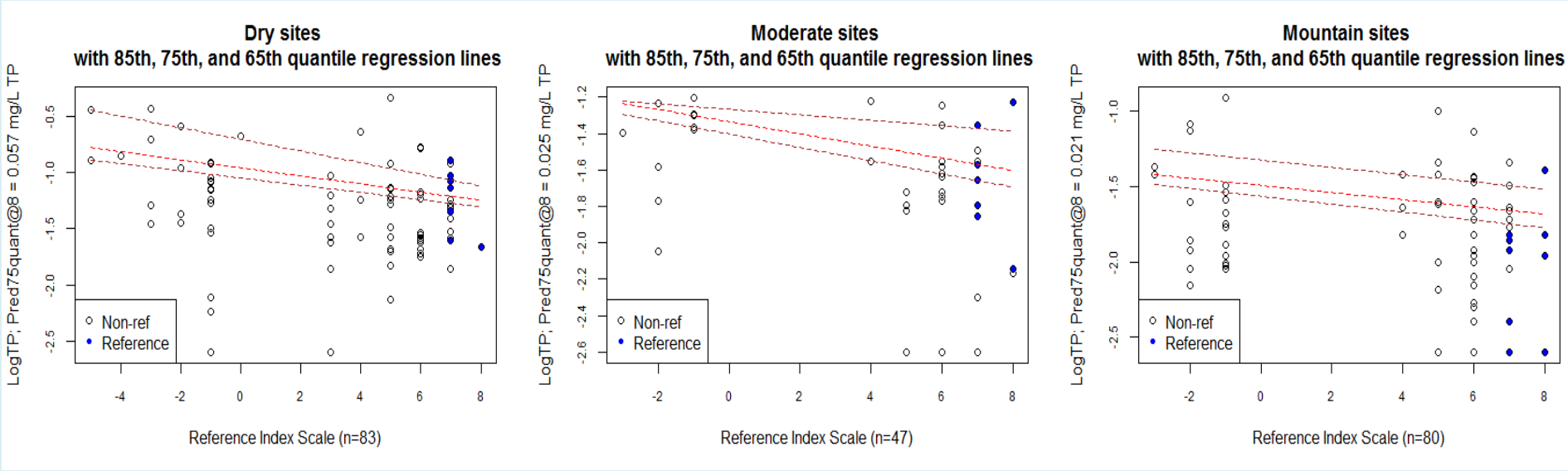
Quantile Regression

TP: against the reference index

Predict 75th quantile at the highest index value (8)



In Site Classes

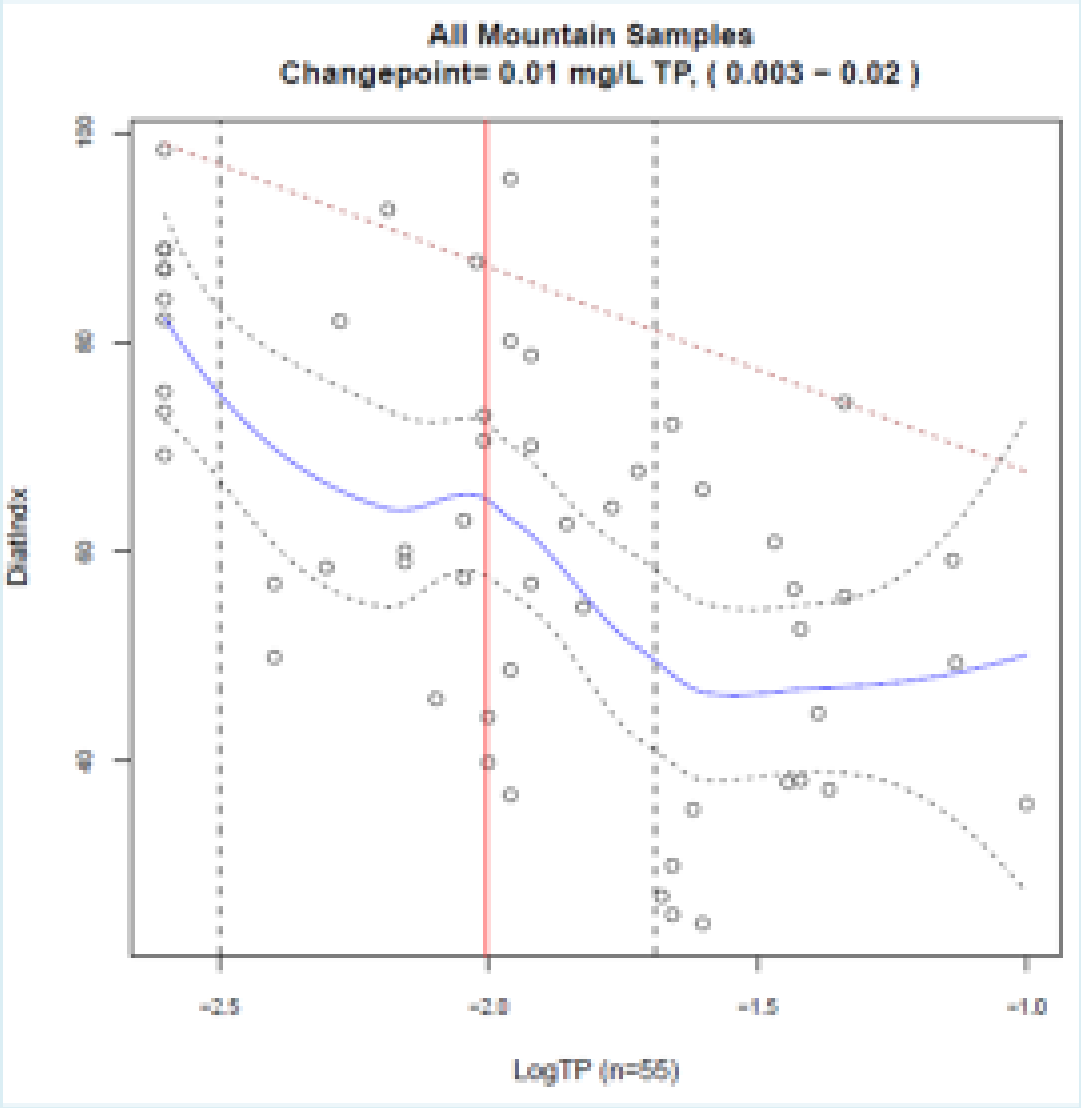


Change-points with Diatom Metrics

CP can be identified for the diatom index and metrics

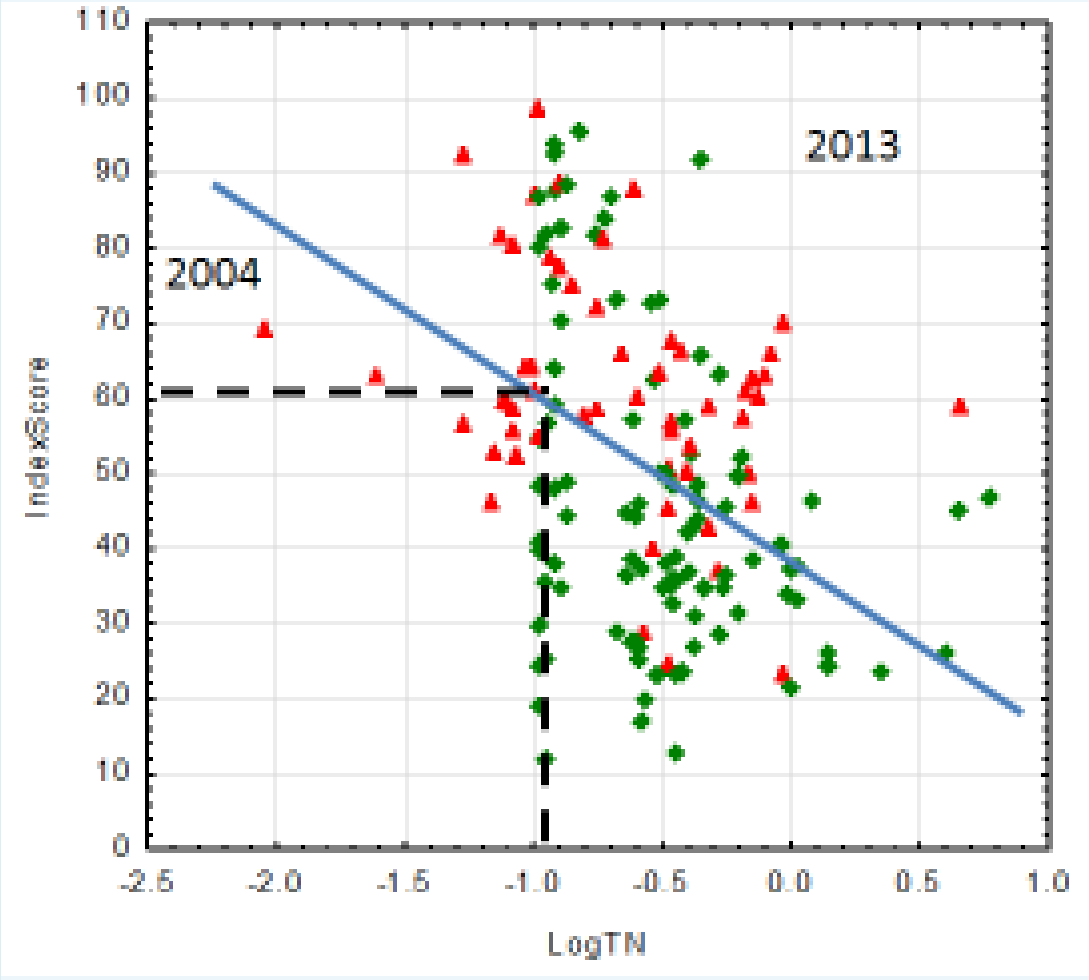
Validity of CPs are scrutinized:

Loess & Quantile Regression



Linear Regression Interpolation

At a given value of the index, what is the value of the nutrient?



Synthesis of Multiple Thresholds

- Use multiple lines of evidence
- Emphasis on reference approaches